

Q1 a) 7 b) {Clubs, Spades} or {Diamonds, Hearts} c) 0

Q2 a) 2401/4096 or .586 b) 3375/4096 or .824 c) $b=12, r=1$ d) too many false positives

Q3 a) $w = (-1/10, 2/15), b = 1$ b) 6 c) (10,10) - (i) only; (10,10) + (vi) only; (20,5) - (iii) and (iv).

Q4 a) 0, 1, and 3 b) 8 c) any a divisible by 4

Q5 a) 2's on the diagonals, -1's elsewhere b) 0 c) 3 d) any unit vector whose components sum to 0 but is not all 0's e) Partition according to the sign of their chosen vector

Q6 a) $(1 - \exp\{-MH/N\})^H$ b) .3934 c) .3996

Q7 a) [8/15, 4/15, 2/15, 1/15] b) 11/15 c) none; everything stays the same d) A and B e) [1,1,1,1]

Q8 a) {Item, Date} b) {Buyer} c) {Item, Buyer, Quantity, Date}

Q9 a) none b) B c) A d) BC first, then A added, then D added

Q10 a) 3 b) 0 c) 21

Q11 a) $pC^2 (1-pC) pD \epsilon (1-\epsilon)$ b) $pC = \frac{2}{3}, pD = 1$ c) $4\epsilon/27$ (OK if they include a factor $1-\epsilon$) d) Increase

Q12 a) 17 b) 7 c) only (0,8)

Q13 a) N b) $N^3/6 - N^2/2 + N/3$ or $\{N \text{ choose } 3\}$ c) $N^3/2 - N^2/2$ or $N\{N \text{ choose } 2\}$

Q14 a)

1 2 3

2 4 6

3 6 9

b) 5 c) 15/7 d) 14/285 or ,049

Q15 (examples for each -- there are many possibilities)

a) $R \rightarrow A$ $R \rightarrow A$ $Q \rightarrow B$ $Q \rightarrow B$ $P \rightarrow C$ $P \rightarrow C$

b) $R \rightarrow A$ $R \rightarrow A$ $Q \rightarrow B$ $P \rightarrow C$ $P \rightarrow B$ $Q \rightarrow *$

c) $P \rightarrow A$ $P \rightarrow B$ $Q \rightarrow A$ $Q \rightarrow B$ $R \rightarrow *$ $R \rightarrow *$

Q16 a) 800 b) 40 c) 300 d) 12,000 e) 40

Q17 a) 3 b) 5 c) S1: aaa, S2: aab many people gave 1, 2 (or even 0, 1) for S1 and S2. We gave them one point) Also note c) is worth 2 points total. d) $\frac{3}{8}$

Q18 a) $A = 3B/4$; $B = A/2$; $C = A/4 + D$; $D = A/4 + B/4 + C$

b) $A = B = 0$; $C = D = \frac{1}{2}$

c) same as (b)

d) essentially any other initial vector, although there are some exceptions that are almost impossible to find

e) 0

Q19: a) 16, 8, 4 b) 2 c) $3 - 2/N$

Q20 a) 2000 b) 100,000 or 60,000 are both consistent with the question. I had planned to state that the items were numbered 0-9999, in which case an array of integers can be used for the count. However, I never said that, so the best general solution needs 8 bytes per item, for a table of item#-count pairs. On the other hand, the question calls for "minimum possible," and if the items happen to be consecutive, then you can use only 4 bytes/item. So we accepted both answers. c) 3000 d) 1,999,000

Q21 a) 1

b) 2 -2

-2 2

c) $(0, [1/\sqrt{2}, 1/\sqrt{2}])$ and $(4, [1/\sqrt{2}, -1/\sqrt{2}])$

d) U and V transposed are both $[1/\sqrt{2}, -1/\sqrt{2}]$ and Sigma is [2]

Q22 a) 0.82 or $2/\sqrt{6}$ b) items 2 and 4 c) $1/3\sqrt{2}$ or 0.236